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Donald R. Moscato

Iona College

Eric D. Moscato

Iona College

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An Evaluation of the Use of a Virtual World Experiential Case Study to Teach Information Systems Auditing Skills

Donald R. Moscato

Iona College

USA

dmoscato@iona.edu

Eric D. Moscato

Iona College

USA

emoscato@iona.edu

ABSTRACT

The paper presents the results of student feedback on the use of an experiential case study of the site audit of a technology and data center constructed in the 3-D virtual world of Second Life. The unique aspect of this case study was that the entire audit was conducted in a virtual world environment. The results of the assessment were extremely favorable and the exercise was recommended to be utilized in future classes. The results include both quantitative as well as qualitative feedback.

INTRODUCTION

A course in computer security and auditing has been taught by one of the authors for over twenty-five years. During that period both case studies and site visits were employed to add a dimension of practical realism to the delivery of the course's subject matter. Events of the past decade have made actual site visits impractical leaving the case study as the primary teaching modality. These cases tended to be characterized as text-based narratives, non-interactive and of limited scope. There have always been adequate resources to support the software and systems components of the course but there was nothing that supported physical site visits. To satisfy this apparent void, a technology and data center was created in a virtual world platform, Second Life, and populated with numerous risk exposures for an organization. The objective is for information systems auditing students to perform a site visit and apply auditing principles as they canvass the physical site. After a number of audit findings were discovered, each student team presented their results in a professional manner using the reporting guidelines of the Institute of Internal Auditors (Moscato & Boekman, 2010).

This paper describes a very creative way to teach the fundamental concepts and principles in performing a physical audit of a data center. To this end, students study the principles of audit and security as part of a course in an information systems program. In this course, an overview of some of the basic principles of auditing and control in an information systems context is covered. Information systems auditing can be taught as part of both accounting and information

systems academic programs. It is important to understand that it is a teachable skill set. IS auditing has a body of knowledge and is recognized as an extension and application of basic auditing principles (Ciampa, 2007). A fundamental concern is how best to teach and practice these skills acquired in a formal academic context? In this case we concentrated on the performance of a physical site visit to a data center. It is a tangible component of a total systems audit which might include software (system and applications) as well as networks and human resource dimensions.

In developing the experiential exercise, we had several questions that we asked.

1. Will students come to the same conclusions about the security issues in the building in this virtual setting as they would in a real world setting?
2. Will they perhaps find more problems?
3. Will they not be as aware due to the simulated venue?
4. Are they able to "translate" this virtual setting into a real life one?

In the discussion of the results, we proceed to answer these questions. It was also a goal to generate a degree of excitement and fun to the learning process. It was believed that using a virtual world modality would satisfy this goal as well as give us the ability to scale the number of exposures in each learning case study.

AN OVERVIEW OF SECOND LIFE

Second Life, a creation of Linden Labs, is a metaverse consisting of simulated islands (each 64,000 square meters in size) called sims (Robbins & Ball, 2008; Rymaszewski et al., 2008). These islands are located in a three-dimensional universe with each having a unique set of coordinates. This feature allows land to be located in several levels each separated from the others. Each island or "sim" can be subdivided into smaller parcels. The virtual world of Second Life is used by its residents for a multiplicity of purposes: business, pedagogy, art, travel and entertainment. For purposes of controlling general behavior of residents, sims are rated as either PG, mature or adult. Since its inception it has been one of the most popular platforms for engaging in virtual world activity.

It is global in its orientation and uses language translators, if needed, to facilitate communication among members who are represented as avatars. Since it is a virtual world, inhabitants are not limited by the typical real world physical limitations. Avatars are capable of flying, seeing into buildings and teleporting around the universe almost instantaneously. The platform was selected for the experiential exercise for several reasons. Second Life provides for a more visual platform for students to interact with the environment of the data center. The platform allows students to engage in joint audits from anywhere in the world. Students meet at the site to perform the audit regardless of their host country. This promotes intercultural group activities across multiple campuses (Moscato & Moscato, 2009a, 2009b). The authors created a virtual technology and data center in the metaverse known as Second Life. As part of the audit, students can "fly" around the site and get a very efficient "lay of the land" as the audit the target system. The design of the site in this medium allows for the instructor to continuously change the configuration and exposures which facilitates repeated use, but with different learning objectives possible. Students

can take numerous screenshots to document and support their audit findings at little out-of-pocket cost.

LEARNING OBJECTIVES

To guide the development of the case study, several learning objectives were established. The following learning objectives informed the design process of the exercise and were the subject of the assessment questionnaire presented in Appendix A:

1. To be able to demonstrate an understanding and application of the basic principles of information systems physical security;
2. To be able to implement basic principles of IS auditing;
3. To demonstrate an understanding and application of the Institute of Internal Auditors guidelines on presenting audit findings;
4. To develop the auditor's observation skills as they canvass a physical target site;
5. To develop a skill and practice in assessing risk exposures and their potential impact on an organization;
6. To develop a skill and practice in presenting audit findings to management in a professional and convincing fashion;
7. To have fun in performing an audit in a highly interactive, experiential modality (Moscato & Boekman, 2010).

AN OVERVIEW OF THE PHYSICAL SITE USED IN THE AUDIT

The case study used in this exercise is based on a building located on a particular sim in Second Life's virtual world which is managed by one of the authors. It occupies a designated amount of space on a much larger sim or island. It is depicted in Figures 1 and 2. The building houses the Technology and Data Center of an organization. The emphasis of the audit is on the security and control that is physically implemented in the target structure (Dhillon, 2007; Easttom, 2006).

Figure 1: Technology Data Center Front View.



Figure 2: Technology Data Center—Back View.



The building consists of four floors, the first being on ground level. Access to all floors is via a conventional elevator located within the building. The project team populated each floor with a number of risk exposures. In addition to the building itself, there are exposures based on the location of the building and how it can interact with its immediate environment. The structure of the experiential exercise permits the professor to readily add or remove the specific exposures incorporated in the exercise. In this manner, the degree of difficulty of the assignment can be scaled both in terms of the number of exposures included as well as their complexity in terms of IS auditing concepts. The version used in the exercise contains more than two dozen plausible risk exposures. The degree of risk exposure varied from minor to very significant. Students navigated to the island, located the building and proceeded to perform a site audit. This audit was conducted over a finite period of time and was available 24/7 during that period. During that period the students could visit the site as individuals or as an audit team.

METHODOLOGY

The course was presented during the Fall Semester of 2010. A total of sixteen students (all of whom were information systems majors) participated. Teams consisting of two or three students each were self-selected. By the time the auditing assignment was undertaken, each student had completed independently a preliminary exercise in creating a Second Life account, personal avatar creation and developed basic navigation skills. The purpose of this initial exercise was to ensure that each student “climbed” the initial learning curve of Second Life and could concentrate on performing the actual physical audit of the data center. Results were analyzed and it was deemed a successful activity and all students were prepared for the next phase. This exercise demonstrated a skill in navigation across the virtual world and within each island as well as the ability to document their travels with screenshots.

Over the course of two weeks the teams visited the site and gathered through observation the data that would be needed to proceed to the next step. At each visit they compiled “screenshot” documentation of each risk exposure that they were able to identify (Ciampa, 2007; Raval &

Fichadia, 2007). The teams used as a basis for their identification of risks the theory and concepts taught in the course (Kim & Solomon, 2012; Newman, 2010). Once the documentation was obtained, the next step was to complete an “audit finding” for each exposure according to the template illustrated in Appendix B. After the collection of audit findings was completed the team was tasked to prioritize the exposures based on organizational impact.

At the conclusion of the course, each student completed the questionnaire that is included in Appendix A.

RESULTS

Table 1 summarizes the results for all eleven questions. The column headings are as follows: question number, mean, mode, range, standard deviation, coefficient of variation, percentage agree (strongly agree and agree), percentage disagree (strongly disagree and disagree) and percentage neutral.

Table 1: Summary of Results.

Question	Mean	Mode	Range	Standard Deviation	Coefficient of Variation	% Agree	% Disagree	% Neutral
1.	4.75	5	4-5	0.43	0.09	100.0	0.0	0.0
2.	4.38	5	3-5	0.70	0.16	87.5	0.0	12.5
3.	4.56	5	3-5	0.61	0.13	93.75	0.0	6.25
4.	4.19	5	2-5	0.88	0.21	81.25	6.25	12.25
5.	4.31	5	2-5	0.85	0.2	87.5	6.25	6.25
6.	4.31	4	3-5	0.58	0.13	93.75	0.0	6.25
7.	4.25	4	3-5	0.56	0.13	93.75	0.0	6.25
8.	4.13	4&5	3-5	0.86	0.21	81.25	6.25	12.5
9.	3.94	5	1-5	1.09	0.28	68.75	6.25	25.0
10.	4.31	4&5	3-5	0.68	0.16	87.5	0.0	12.5
11.	4.31	5	1-5	1.21	0.28	87.5	6.25	6.25

A review of Table 1 shows that the means of the responses ranged from a low of 3.94 to a high of 4.75 on a scale of one- to -five. The modal responses were either a four (two times) or five (seven times) or both four and five (two times). The standard deviation ranged from a low of 0.43 to a high of 1.21 with all but two questions having a standard deviation below 1.0. The range of the coefficient of variation (standard deviation/ mean) was a low of 0.09 to a high of 0.28 which indicates a relatively low degree of variability of responses for each question.

In only one question (#9) was the degree of favorability less than 81% among all of the students. That result improves to over 93% when those respondents reporting a neutral response are considered. Only 6.25% disagreed that the exercise enhanced their understanding of security and auditing. This question also had the lowest mean value and the second highest standard deviation

and coefficient of variation which means this question had the highest variability of responses across all of the survey questions.

ANALYSIS OF RESULTS OF EACH QUESTION

Question 1

All of the students agreed that the first exercise helped them with learning the navigation skills that were needed to complete the audit with a great deal of ease. This question had the least relative variability of responses (coefficient of variation was 0.09) and the highest average score was 4.75/5.00 (see Appendix A).

Question 2

Most respondents (87.5%) agreed and 12.5% were neutral that because of the first exercise they could focus on the actual audit and not on the secondary aspects of navigating a virtual world environment. No one disagreed. There was also very little relative variability within the responses.

Question 3

Most respondents (93.75%) agreed that the repetitive aspects of presenting multiple audit findings helped them in their understanding of how to present audit findings to management. No one disagreed. This question had the second highest mean (4.56/5.00) and the second lowest measure of variability (0.13).

Question 4

Most respondents (81.25%) agreed that completing the auditing exercise in a virtual world environment improved their observational skills in identifying risk exposures in a data center. Only 6.25% disagreed. This question elicited the second highest relative variability of the survey questions (0.21).

Question 5

Most respondents (87.5%) agreed that they were surprised by the number of risk exposures that could be found in a site audit of a data center. Only 6.25% disagreed.

Question #6

Most respondents (93.75%) agreed that because of the exercise they better understood the challenges inherent in the prioritization of audit findings in presentations to management. No one disagreed. This question had the second lowest relative variability of responses (0.13).

Question 7

Most respondents (93.75%) agreed that they had a better grasp of the magnitude of risk exposure inherent in a technology and data center site. No one disagreed (see Appendix C for several examples). This question had the second lowest relative variability of responses (0.13).

Question 8

Most respondents (81.25%) agreed that they understood better the underlying skill sets needed to perform a site audit. A few respondents were neutral (12.25%) in their assessment, while 6.25% disagreed. This question elicited the second highest relative variability of the survey questions (0.21). The mean response was 4.13/5.00 and was the second lowest.

Question 9

Of all the questions in the survey this one generated the lowest mean score among the respondents (3.94/5.00) and the highest relative variability (0.28). Most respondents (68.75%) agreed that the audit exercise significantly enhanced their understanding of computer auditing and security. A quarter of the respondents were neutral and only 6.25% disagreed.

Question 10

The purpose of this question was to determine if this virtual world exercise, or another version of it, should be employed in future courses. Most respondents (87.5%) agreed that it should be maintained and the remaining respondents were neutral. No one disagreed. This finding was heartening in that, at the outset, there was some doubt as to the degree of positive response that the new initiative would generate among the students given the amount of work required.

Question 11

This question was asked to assess whether the students felt that working in teams was productive in this context. Recall that each person completed the first exercise independently and was later assigned to self-selected teams. Even though everyone had the basic skill set required it is assumed that motivation and effort were the "wildcards" in eventual successful team performance. Most respondents (87.5%) agreed that working in teams was helpful and the remaining respondents were neutral (6.25%) or disagreed (6.25%). The mean score was good (4.31/5.00) even with the highest relative variability (0.28).

It is clear from the results of each question that the students overwhelmingly found the experiential exercise to be a positive contribution to learning the subject matter under review. In the next section we report on the two open-ended questions asked of the students in the course.

RESPONSES TO OPEN-ENDED ASSESSMENT QUESTIONS

In the first part of this section we present and comment upon the responses of the students to the question: *"What was the biggest challenge you faced in completing the exercise?"* If these responses are compared to the learning objectives stated previously, it is heartening to note how well they correlate. The comments are listed as follows:

- Deciding what criteria to apply in each instance
- Bringing it all together in one document
- Understanding the initial audit environment
- Prioritizing the audit findings
- Assessing the risk potential of the found exposures
- Determining values for the potential losses
- Home computer was inadequate to handle virtual world software
- Too many audit findings to process.

In the next part of this section we present and comment upon the responses of the students to the question: *"How could the assignment be improved?"* The comments are listed as follows:

- Would like to see all other teams' reports
- Teams should be larger
- Have certain teams focus on different parts of the data center audit
- Utilize other sites in the audit
- Have a pre-existing template for rating each exposure
- Have fewer risk exposures and focus on them
- Have readily available industry standards for sites and equipment costs.

In retrospect, having over two dozen risk exposures inherent in the site did add significant work to the exercise. The logic behind including so many was that not all would be identified by the auditors. In fact, most were and as a result the workload increased proportionately. A casual review of Appendix C would illustrate the point that over two dozen of these findings necessitated a great deal of analysis not only to discover and document but also to assess their relative importance. A review of Appendix C documents (Figures C1, C2 and C3) the professional appearance of the representative findings.

SUGGESTIONS FOR FURTHER STUDY

This case is a continuing component of ongoing research into social networks by the authors. Further research should be done about the use of social networks in education. The case presented here has been used as a simulation in a university class in computer auditing and security. Future subjects to be addressed are as follows:

- Do simulations of this type represent real life well enough to be effective teaching tools?
- Will students be able to "translate" this virtual setting learning experience into a real life one?
- Expand the scope of audits to include other than physical site audits.

- We can improve the experiential exercise by providing a tighter rubric for presenting and prioritizing risk exposures.
- We found that students enjoyed working in a virtual environment. However, one can ask if students will use it as a game and minimize the pedagogical aspects? How interested are they in virtual worlds? What will students use virtual worlds for?
- What other possibilities arise when working and doing research in a virtual environment? How about working with people all over the world, on a daily basis as we did in preparing this simulation case? It was almost like working with your colleagues at work. What kind of possibilities will this create for collaboration in virtual teams?

There are many more questions about virtual world versus real life. Questions arise about communication, marketing and conducting business. But also in what areas virtual environments can be used. In this case we focused on education, but what about healthcare, culture, art and design, informing people about all kinds of subjects, conferences, etc.? We seem to be just at the start of a whole new revolution in communicating and interacting with each other. Will the explosive rise in social networking and virtual worlds change our lives as profoundly as the Internet did?

SUMMARY AND CONCLUSIONS

This paper presented the results of student feedback from participation in the audit of a virtual replica of a physical technology and data center created in the virtual 3-D environment using Second Life as the platform. The purpose of the exercise was to develop the observation skills, to promote teamwork, to develop risk assessment skills and reporting skills of students in an information systems class on security and auditing offered in a business school university environment. Based on the findings of the research, it is clear that students responded favorably to the experiential exercise despite the added requirement to learn the skill set required to navigate in a novel 3-D virtual environment. Even though the size of the class was not large, the findings are overwhelmingly positive and encouraging.

The use of a virtual world to teach auditing concepts has several clear advantages. First, the environment of Second Life and its ilk contains a richness that cannot be captured with traditional case study approaches that utilize words only. Second Life is visual, interactive and fun. A properly designed virtual situation can replicate the characteristics of a real world auditing environment at a significantly lower cost than the real thing. Of course, this presupposes the ability to access a real data center and perform an audit for training purposes which is often not practical in a university environment. The costs would be prohibitive. Using a virtual environment allows the educator to create a realistic replica of an actual situation and using the methodology of a gaming simulation adds a dimension of fun and excitement to the learning process.

A second conclusion obtained is that the instructor is able to vary significantly the number of exposures included in any simulated environment. Thirdly, the environment can change in order to accommodate the learning objectives inherent in the subject matter. This exercise focused on a physical site audit of a data center but can be extended to encompass many different situations. A

fourth conclusion emanating from the exercise was the development of the students' ability to prioritize risk exposures and present their findings in a manner consistent with acceptable business practices.

Fifthly, auditors in training have the opportunity to hone their observation skills which are necessary in any site visits they will make in the real world. As they navigated the data center, they were able to match their training to what they see before them in the building. They encountered situations similar to what they will experience in any real world audit.

Lastly, learning and applying auditing of information systems principles in an actual setting can be fun as well as educational.

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APPENDIX A

Second Life Physical Site Audit Questionnaire

Using a 5 point rating scale with the following meaning, rate each question:

- 1 - Strongly Disagree
- 2 - Disagree
- 3 - Neither Disagree or Agree
- 4 - Agree
- 5 - Strongly Agree

Please circle the appropriate response.

1. Developing Second Life navigation skills were easy to learn by completing the **first exercise** format 1 2 3 4 5
2. Having developed the initial skill sets in S.L. from the first exercise enabled me to better focus on the case exercise tasks 1 2 3 4 5
3. Completing the 5-point audit findings report multiple times contributed to my understanding of how to **present audit findings to management** 1 2 3 4 5
4. Completing the SL audit exercise contributed to the development of my **observation skills** required in the performance of a site audit 1 2 3 4 5
5. I was surprised to realize **how many exposures** are inherent in a physical site audit 1 2 3 4 5
6. I better recognize the challenges in **prioritizing audit findings** that result from performing an audit 1 2 3 4 5
7. I better recognize the challenges in assessing the **magnitude of risk exposure** from individual components of an audit 1 2 3 4 5
8. The physical site audit helped me better comprehend the overall skill sets needed to perform a physical audit 1 2 3 4 5
9. Overall, the audit exercise significantly **enhanced my understanding** of computer auditing and security 1 2 3 4 5
10. I recommend having **this exercise format** as a learning component module in this course for future IS students 1 2 3 4 5
11. **Working on teams** for this exercise was helpful 1 2 3 4 5
12. The biggest challenge in successfully completing this assignment was _____
13. To make this assignment more beneficial to me, I would recommend the following: _____

APPENDIX B

The following five points constitute the architecture of the audit findings framework as presented by the Institute of Internal Auditors (2010).

(1) *The Statement of Condition*

This contains the factual (observed) evidence of the current state. It can be thought of as the "what was" part of the report.

(2) *The Criteria*

This is our reference point or standard/protocol that is use to measure against the current condition observed by the auditor.

(3) *The Effect*

Preferably stated with a monetary value; it represents the degree of risk or exposure incurred as a result of the deviation from the standard.

(4) *The Cause*

This is the auditor's opportunity to explain why there is a deviation from the stated standard. Often, this is a result of people not performing their assigned duties but can also be the result of no one person being held responsible for an entity.

(5) *The Recommendation*

This is the opportunity for the auditor to state to management what could be done to rectify the identified exposure? In other words, what to do now?

APPENDIX C

Figure C1: Second Life Screenshot to Document Risk Exposure—Security Issue.

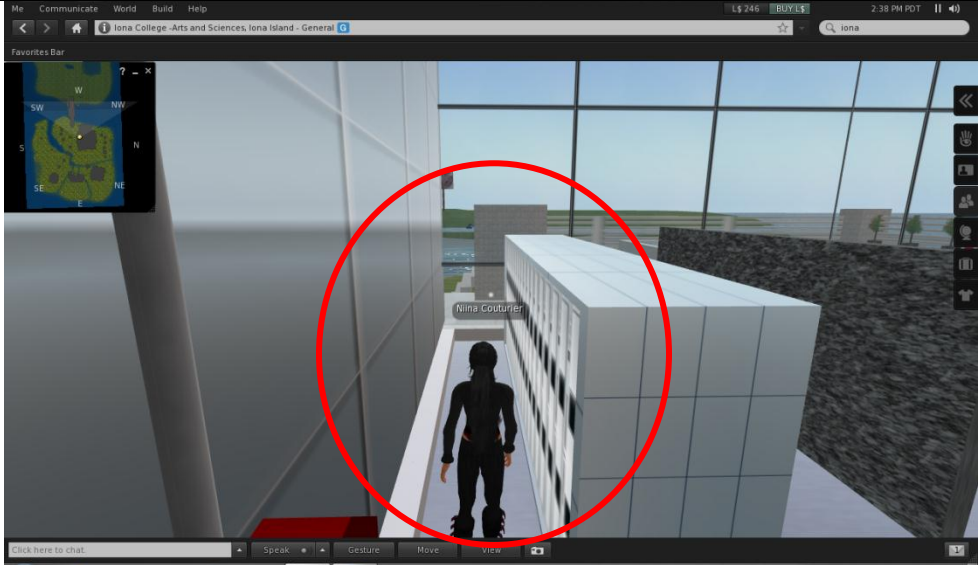
No. 1	Auditor: Nicole Harty/Desiree Volz/Victor De Oleo	Date: 11/01/2010
Audit Subject	Technology and Data Center: Floor 1(Main): Server Behind Wall	
Audit Concern Title	Server is unprotected and easily accessible.	
Statement of Condition		
Criteria	Security issue—the server is a risk and should be safe and secured in a locked room.	
Effect	\$10,000	
Cause	The server is the company’s core and main supply of information.	
Recommendation	The company should move the server to a separate, secure, and confined room.	

Figure C2: Second Life Screenshot to Document Risk Exposure—Security Issue.

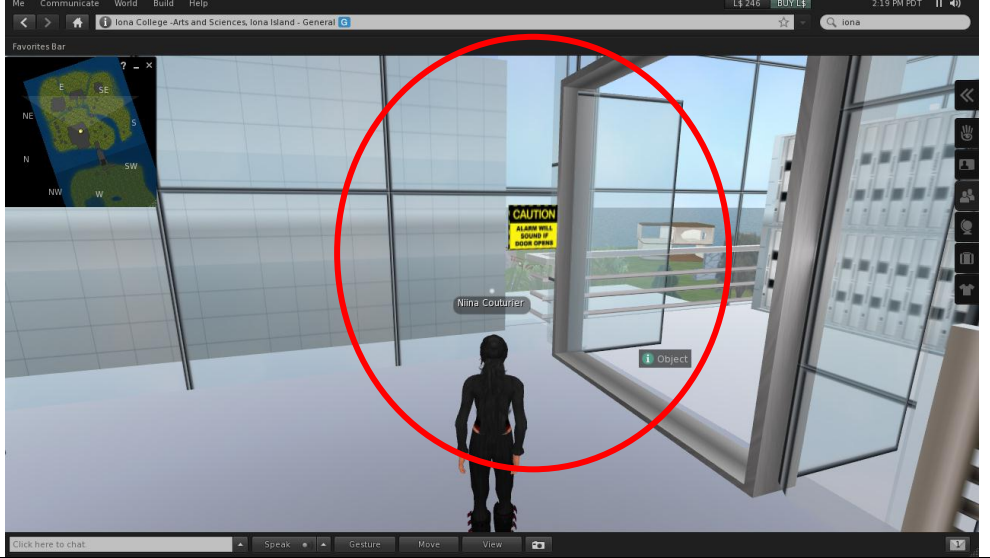
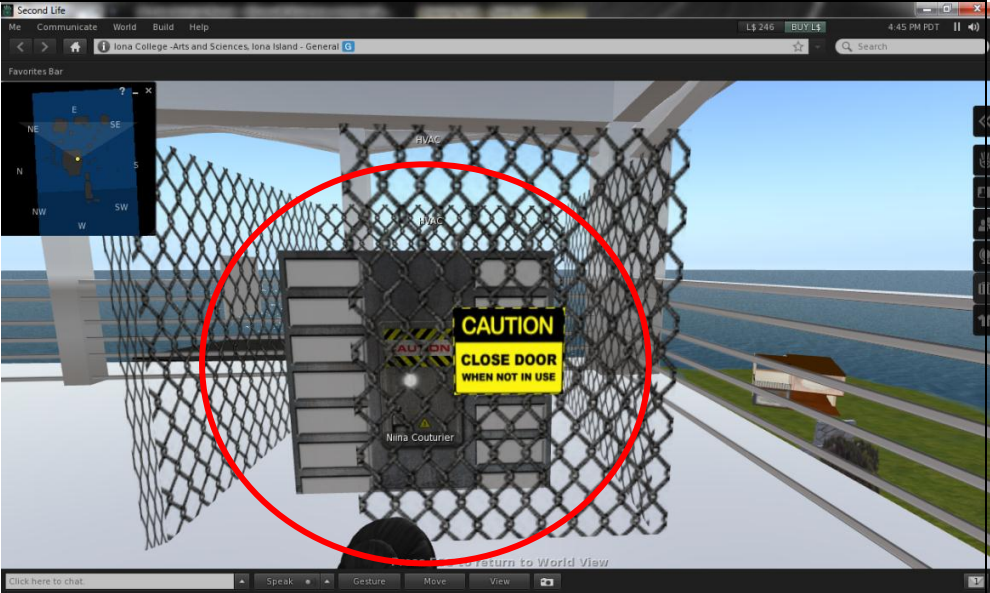
No. 2	Auditor: Nicole Harty/Desiree Volz/Victor De Oleo	Date: 11/01/2010
Audit Subject	Technology and Data Center: Floor 2: Server	
Audit Concern Title	Server door is open and not secure.	
Statement of Condition		
Criteria	Security issue—the server is at risk.	
Effect	\$10,000	
Cause	Sign says alarm will sound if the door is opened; alarm sounds off but anyone can still enter the server room.	
Recommendation	Create a control that can be enforced; in this case, when the alarm sounds, have security check the server room.	

Figure C3: Second Life Screenshot to Document Risk Exposure—Safety Issue.

No. 3	Auditor: Nicole Harty/Desiree Volz/Victor De Oleo	Date: 11/01/2010
Audit Subject	Technology and Data Center: Floor 3 (Top): Open Lecture Area: HVAC	
Audit Concern Title	HVAC door is not closed.	
Statement of Condition		
Criteria	Safety issue regarding the HVAC—the door should be kept closed at all times.	
Effect	\$5,000	
Cause	The HVAC door was not closed, leaving it open to anyone, which could potentially lead to damage and be harmful to employees and students.	
Recommendation	The company should have the HVAC in an enclosed area that is confined and secure away from employees and students.	